ORIGINAL
(Red)

GROUNDWATER
TECHNOLOGY, INC.

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OBSERVATION WELL INSTALLATION
AND
GROUNDWATER SAMPLING
AT THE
MACK TRUCKS, INC.
5C FACILITY
ALLENTOWN, PENNSYLVANIA

PREPARED FOR:

MACK TRUCKS, INC.
2100 MACK BLVD
ALLENTOWN, PA

PREPARED BY:

GROUNDWATER TECHNOLOGY, INC.
CHADDS FORD WEST
US ROUTE 1
CHADDS FORD, PA

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1.0 INTRODUCTION AND BACKGROUND

The Mack Trucks, Inc. 5C facility is located in the city of Allentown, Pennsylvania between south Twelfth Street and Mack Boulevard (see figure 1).

This is the site of a previous production facility where heavy duty trucks were assembled. The plant has been relocated and this facility now lies vacant.

Dames and Moore of Willow Grove, Pennsylvania conducted an environmental assessment of the facility as part of a property transfer. Dames and Moore concluded that an area of groundwater degradation exists in the vicinity of the Wash House, which lies along the western property line as depicted on Figure 2. In order to further evaluate this area of concern, Groundwater Technology, Inc. (GTI) was contracted to install six additional observation wells, five on the adjacent property (Queen City Business Center) and one additional on-site well.

This report outlines the methods and finding of this investigation, and makes recommendation for future work.

2.0 FIELD ACTIVITIES

2.1 Observation Well Installation

2.1.1 Methodology

On 1 April 1989, Groundwater Technology, Inc. installed 5 observation wells on the Queen City Business Center property as depicted on Figure 2. Also on this day a sixth well was installed on the Mack Trucks property. Figure 2 indicates the location of these new wells along with the existing wells in the vicinity of the Wash House. The new wells are designated with the "OW" prefix while the previously installed wells are identified with the "MT" prefix.

The wells were installed using an air rotary drill rig with an 8" O.D. hammer bit. All soil and rock cuttings generated during the drilling were loaded on a truck and transported to a staging area on the Mack Truck property. The drilling activity was logged by a GTI geologist and the actual drill logs are included under Appendix I. During the drilling activity ambient air monitoring was conducted for health and safety reasons using a Foxboro model 128 Organic Vapor Analyzer.

After the wells were drilled 4" PVC well screen and casing were installed in the borehole. Observation wells 2, 3, 4, and 6 needed to have 6" field slotted steel installed to keep the hole open. The 4" PVC screen and casing were then installed inside of this steel. The annular space of each well was filled with #2 gravel pack for the entire screened interval. The wells were developed using the air lifting technique to lift out any formation fines which may have settled into the well. This procedure also helps to settle the gravel pack. All development water was containerized and temporarily stored on the Mack Trucks property.

After the wells were developed and the gravel pack was settled by the development process, additional gravel pack was placed in the well annulus to ensure a complete gravel pack for the entire screened interval. A two foot minimum bentonite seal was placed above the gravel pack and activated with distilled water. Each well head consists of a brass ring mounted on top of the PVC casing with a step-down locking cap, a lock, and a flush mount 12" manhole cover graded to the surface. Figure 3 represents the typical well construction. The wells were surveyed into the existing datum points (from Dames and Moore) to provide horizontal and vertical control.

2.1.2 Summary of Findings

The drilling activity for the observation well installation reveals the subsurface lithologies across the area. The lithologies are consistent with historical data for this area. The bedrock was encountered at varying depths across the site, and consists of a fractured microcrystalline dolomite of the Cambrian Allentown Formation. Bedrock is overlain by weathered dolomite and fill material.

During the drilling activity a shallow water table aquifer was encountered at varying depth across the site. Each well was designed to allow groundwater flow from the saturated zone directly into the observation well (i.e., the screened interval extends partially into the vadose zone). This facilities the accumulation of any phase separated hydrocarbons which may be floating on the water table.

2.2 Groundwater Sampling

2.2.1 Methodology

Representative groundwater samples were collected from each of the newly installed observation wells (OW1-OW6), as well as

previously installed wells MT-15 and MT-16. All sampling equipment was decontaminated by steam cleaning before being brought to the site. A stainless steel submersible pump was used to purge each well. The discharge line from the pump was replaced and the pump decontaminated by steam cleaning between wells. Each well was purged until pH, conductivity and temperature had stabilized (±10%), or until 3 well volumes were removed, whichever took longer. The purge water was containerized and temporarily stored on the Mack Trucks property.

Groundwater samples were then collected using a 24-inch long bottom-loading teflon surface sampler. The twine used to lower the surface sampler was replaced and the surface sampler was decontaminated between sample collections. The decontamination process for the surface sampler involved three polyethelyene containers in series; the first was filled with an Alconox and distilled water solution, the second and third were filled with distilled water only. The sampler was disassembled and scrubbed in the Alconox solution and then double rinsed in the other two containers. Disposable latex surgical gloves were worn at all times for handling the decontaminated equipment. Samples were collected into 40 ml septum capped vials with appropriate labels and custody seals. A chain-of-custody form was initiated and accompanied the samples throughout the shipping and receiving process.

The samples were placed on ice and shipped via an overnight courier to the analytical laboratories. Samples from wells OW-1, OW-2, OW-3, OW-4, OW-5, OW-6, MT-15 and MT-16 were sent to GT Environmental Laboratories, Inc. in Milford, New Hampshire. A duplicate sample was collected from OW-4 and sent to Lancaster Laboratories, Inc. in Lancaster, PA. Quality Control blanks (rinsate, field and trip blanks) were also sent to GT Environmental Laboratories. All samples were analyzed for purgeable halocarbons and purgeable aromatics via EPA Methods 601 and 602 respectively.

Throughout the sample collection process, Mr. David Paiko of

Environmental Resources Management, Inc. (ERM) was present, and split samples were collected by Mr. Paiko for separate laboratory analyses. Mr Paiko was present as a representative of the Queen City Business Center.

2.2.2 Summary of Findings

The sample analyses indicate a degradation of groundwater quality exists in this area. The laboratory analyses included in Appendix II exhibit elevated levels of purgeable halocarbons and purgeable aromatics in most of the wells sampled. The most frequently identified compound is Trichloroethylene. This compound is present in all of the wells sampled along with other related chlorinated species (i,e, 1,1,1-Trichloroethane, Trans-1,2-DiChloroethene, Tetrachloroethylene, etc.). Figure 4 illustrates the distribution of Trichloroethylene (TCE) concentrations based on the laboratory analyses of the eight wells sampled. The data from GT Environmental Laboratories was used to generate this isoconcentration diagram. The highest concentrations of TCE were reported in wells OW-3 and OW-4, which were installed on Queen City Business Center's property. The analytical results for the eight wells sampled are summarized on the following Table I.

Table I
Purgeable Halocarbons (601,602)
Analytical Results Summary
(results in ppb)

Compounds Detected	OW-1 (GTEL)	OW-2 (GTEL)	OW-3 (GTEL)	OW-4 (GTEL)	OW-4 (L.L)	OW-5 (GTEL)	OW-6 (GTEL)	MT-15 (GTEL)	MW-16 (GTEL)
1,1-DCE	ND	ND	ND	ND	<100	ND	ND	32	ND
1,1-DCA	ND	ND	ND	ND	<100	ND	0.4	11	ND
t-1,2-DCE	2.8	2000	4,600	3,700	3800	15	5.6	1,800	ND
1,1,1-TCA	2.7	ND	90	32	<100	ND	0.65	170	ND
TCE	61	110	19,000	13,000	31000	70	18	1,500	230
PCE	0.29	ND	58	29	<100	0.78	0.55	18	ND
Vinyl Chloride	ND	910	590	390	500	ND	ND	50	ND
Chloro Benzene	ND	51	220	3,800	2400	0.49	ND	110	ND
Di Chloro Benzene	ND	52.	68.6	202	NR	0.5	ND	14.2	ND

GTEL = GT Environmental Laboratory results
L.L. = Lancaster Laboratory results
ND = Not detectable
BDL = Below detection limit
NR = Not reported

In addition to these compounds, methylene chloride was detected in OW-1 at 0.53 ppb, however the field blank analyses also list this compound as being present at 2.8 ppb, which makes the detection in OW1 questionable.

In an effort to assess the migration of groundwater containing dissolved gasoline constituents (Benzene, Toluene, and Ethyl Benzene), the distribution of these compounds was assessed independent of the TCE constituents. A phase separated gasoline product plume has been reported in the vicinity of MT-10 on the Mack property. Figure 5 illustrate the distribution of these dissolved gasoline indicator compounds. The following Table II summarizes these results.

TABLE II
Purgeable Aromatics (Gasoline Indicators)
Analytical Results Summary
(results in ppb)

	OW-1 (GTEL)	OW-2 (GTEL)	OW-3 (GTEL)	OW-4 (GTEL)	OW-4 (L.L.)	OW-5 (GTEL)	OW-6 (GTEL)	MT-15 (GTEL)	MT-16 (GTEL)
Benzene	BDL	76	5.2	86	<200	ND	ND	3.0	0.4
Toluene	0.8	22	35	36	<100	BDL	ND	33	2.0
Ethyl Benzene	ND	70	3.5	11	<100	BDL	ND	1.1	BDL
Total	0.8	168	43.7	133	<400	BDL	ND	37.1	2.4

GTEL = G.T. Environmental Laboratory results
L.L. = Lancaster Laboratory results
ND = Non-detectable
BDL = Below Detection Limit

The laboratory data generated as part of this overall assessment should be compared to the data generated by Dames and Moore during the previous assessment. Monitor wells MT-15 and MT-16 were sampled by Dames and Moore on 30th September 1988 for various analyses including EPA methods 601 and 602. This 30th September sampling event for MT-15 produced a TCE concentration of 28,000 ppb while the more recent sampling event conducted by GTI in April 1989 produced a TCE concentration of 1,500 ppb. The 30th September sampling did not identify quantifiable concentrations of Benzene, Toluene or Ethyl benzene in MT-15. The more recent sampling quantified 3.0 ppb of benzene, 33 ppb of Toluene and 1.1 ppb of Ethyl Benzene in MT-15. MT-16 was reported to have 62 ppb of TCE in September and 230 ppb of TCE in April. Benzene, Toluene and Ethyl benzene were not quantifiable in MT-16 in September and were 0.4 ppb, 2.0 ppb and below detection limit respectively as a result of the April sampling.

The replicate sampling and analysis of OW-4 produced markedly different results. GT Environmental Laboratories reported a value of 13,000 ppb for TCE while Lancaster Laboratories reported a value of 31,000 ppb. This large of a discrepancy is un-explained. The QA/QC field blanks collected indicate adequate procedures were used for decontamination in the field. However, during analysis and interpretation of this data the lower value of 13,000 ppb of TCE in OW-4 (obtained by GTEL) was used in order to remain consistent.

2.3 Water Table Gradient Measurements

2.3.1 Methodology

The newly installed wells were surveyed into the existing monitoring network for horizontal and vertical control. The elevation of each well head is listed on the liquid level chart in Appendix III. The water table elevations also listed on this chart were collected on 4 May 1989, and correspond with the water table gradient map included as Figure 6.

Liquid levels were obtained by lowering an electronic sensing device, which is capable of detecting water or phase separated hydrocarbons independently. The probe cable is actually a measuring device and liquid levels can be measured to ± 0.01 feet accuracy. When lowering the probe into a layer of phase separated product a solid tone is heard, and when water is encountered, a discontinuous tone is heard. Liquid levels were measured from the least contaminated well to the most contaminated well with decontamination by an alconox/distilled rinse between each measurement.

Liquid level measurements were subtracted from the surface elevation to obtain the water table elevation of each well at the time of measurement. Where phase separate product is present (MT-10), the product thickness is multiplied by 0.7, and this figure is added to the apparent groundwater elevation to estimate the actual groundwater elevation. This compensates for the density difference of the petroleum product.

2.3.2 Summary of Findings

The data provided by these measurements reveal a water table gradient as depicted on Figure 6. The gradient direction is to the North and the slope varies between 1 and 5%. This trend indicates a discharge area to the North, possibly the Little Lehigh Creek.

It should be noted that wells 9A and 9B indicated a downward vertical gradient based on the construction of these wells and the elevational differences measured between them.

In an effort to identify general trends in potential groundwater movement, cross section diagrams of the site were generated. Figure 7 indicates the cross sections evaluated. Cross section A-A' (figure 8) represents the groundwater elevation along the major axis of groundwater gradient. From this figure it is

3. CONCLUSIONS AND RECOMMENDATIONS

The findings of this investigation predicate the following conclusions:

- Groundwater quality in the vicinity of MT-15 is impacted with TCE. However, the magnitude of the reported TCE concentration is an order of magnitude less than the only other sampling event performed on MT-15 approximately seven months prior to the subject sampling event. Groundwater quality cross-hydraulic gradient of MT-15 indicates that off-site wells contain TCE of concentrations an order of magnitude greater than that reported in MT-15. The data from this single sampling event indicates that the source of TCE contamination in MT-15 is off-site.

- Olfactory responses during the drilling of OW-4 (see drill logs) indicate the potential presence of volatile organic compounds in the unsaturated soils encountered during drilling. A potential source of groundwater contamination therefore exists in the soils surrounding OW-4.

- Groundwater quality in the vicinity of MT-10 is impacted with gasoline indicator compounds (Benzene, Toluene, Ethyl Benzene). The free phase gasoline evidenced in MT-10 has potentially impacted the groundwater in off-site well OW-2 based on a review of the groundwater elevation data. However, the groundwater elevation data does not support the free phase gasoline in MT-10 causing an impact in off-site wells OW-3 and OW-4 (for gasoline type volatile organic compounds). The presence of these gasoline type compounds in wells OW-3 and OW-4, which are up hydraulic gradient from OW-2, indicate a second potential source for the compounds observed in OW-2.

It should be emphasized that these conclusions are based on the results of a single sampling event. Further, the results of this sampling event partially contradict the results of a sampling performed 7 months prior on well MT-15. For these reasons it is recommended that the following actions be taken in an effort to confirm the results reported herein and identify potential sources for groundwater contaminations.

- Conduct a confirmatory sampling of select monitor wells to substantiate previous results. This sampling should be performed in conjunction with a Quality Assurance program which will validate the laboratory data received.

- Continue monitoring the groundwater elevations to identify any variations in the apparent groundwater gradient over the course of the hydrologic cycle.

- Further investigate the potential source of contamination in the soils in the vicinity of OW-4. This could be in the form of a soil gas survey or soil boring program. If possible the investigation should extend into the Conrail right of way.

- Initiate groundwater control and free product recovery in the vicinity of MT-10.

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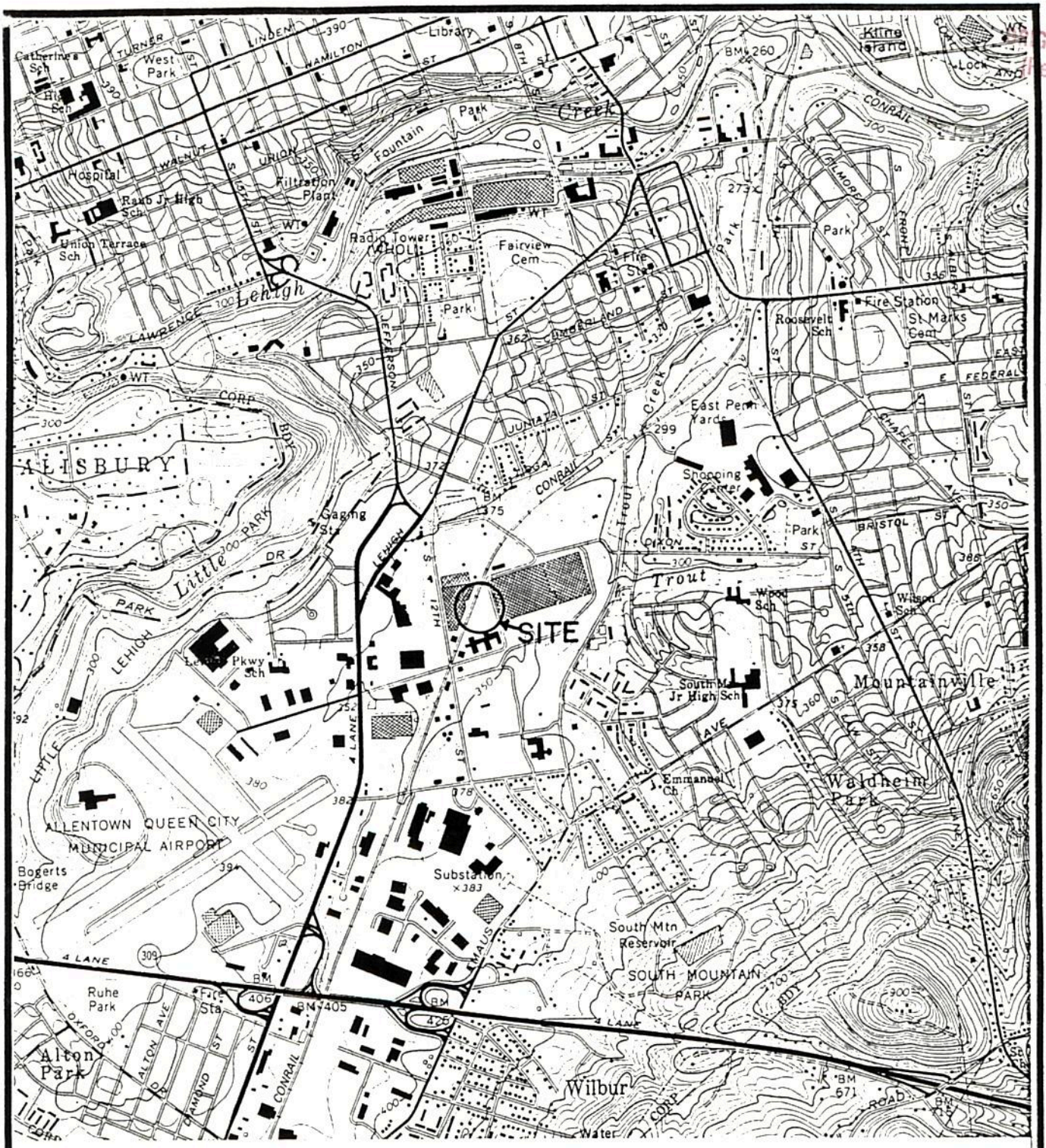

FIGURE I
SITE LOCATION
MACK TRUCKS - 5C
ALLENTOWN, PA.

SOURCE: U.S.G.S. QUADRANGLE
ALLENTOWN, PA., EAST
7.5' SERIES

GROUNDWATER
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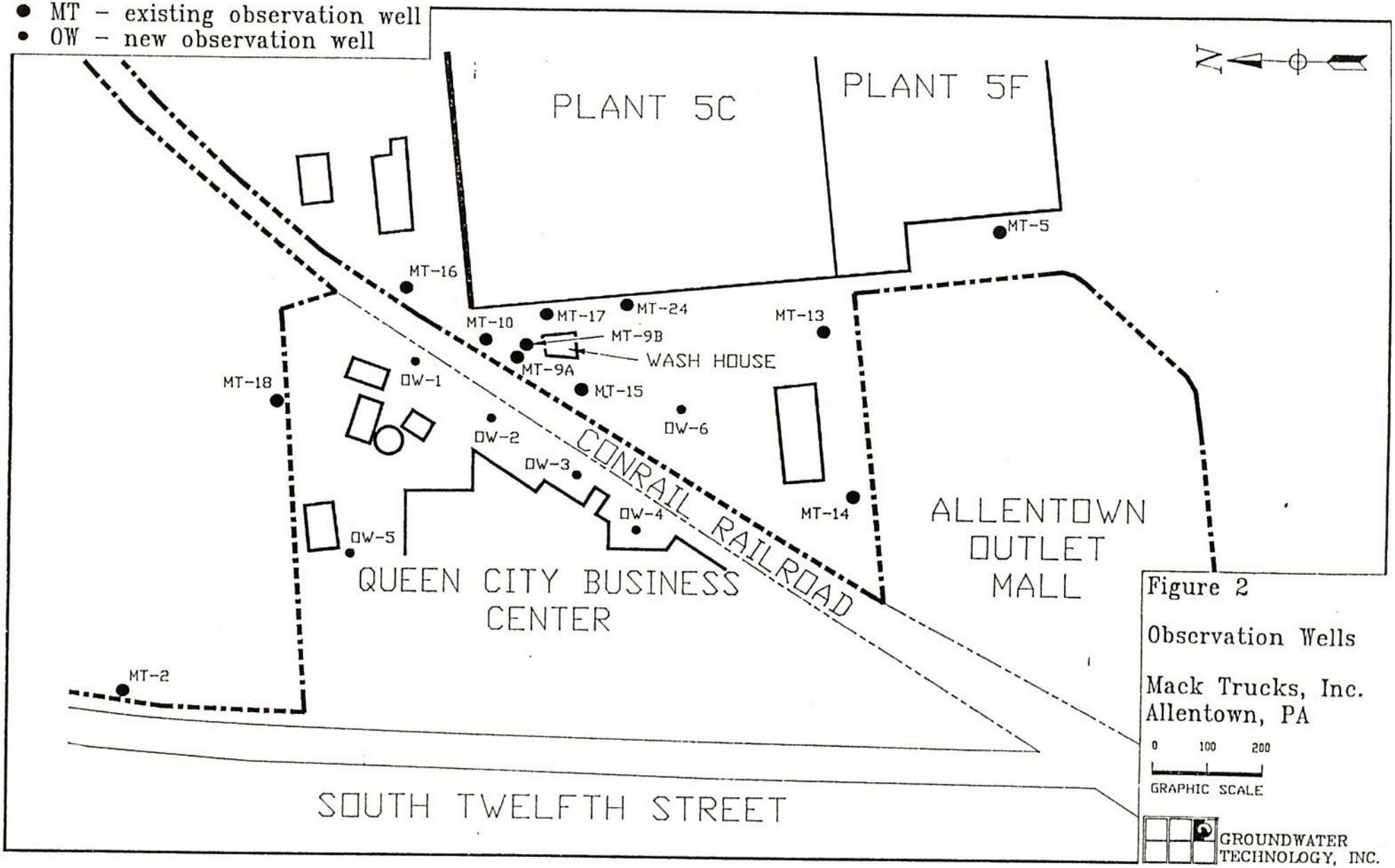

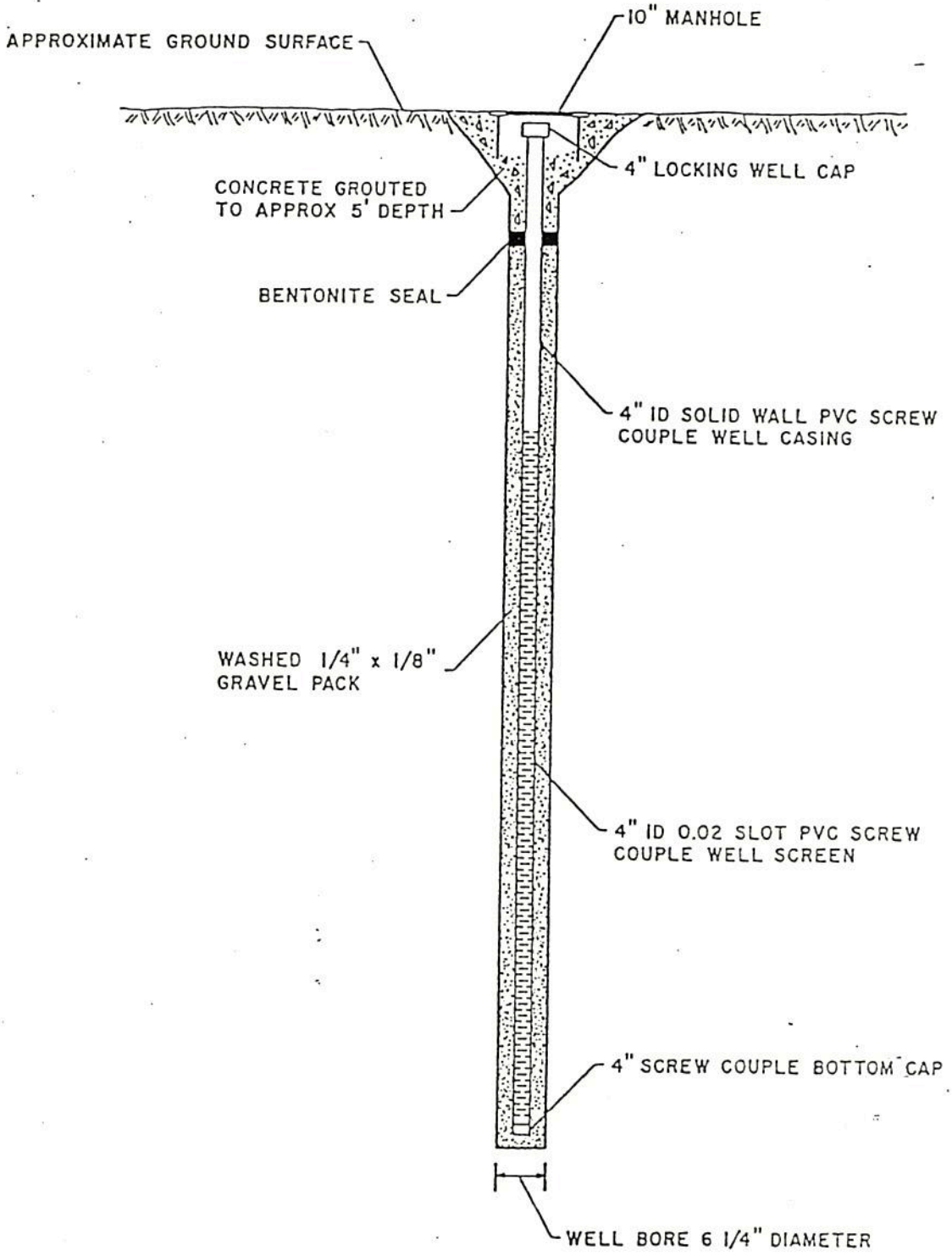

FIGURE 3
TYPICAL WELL CONSTRUCTION

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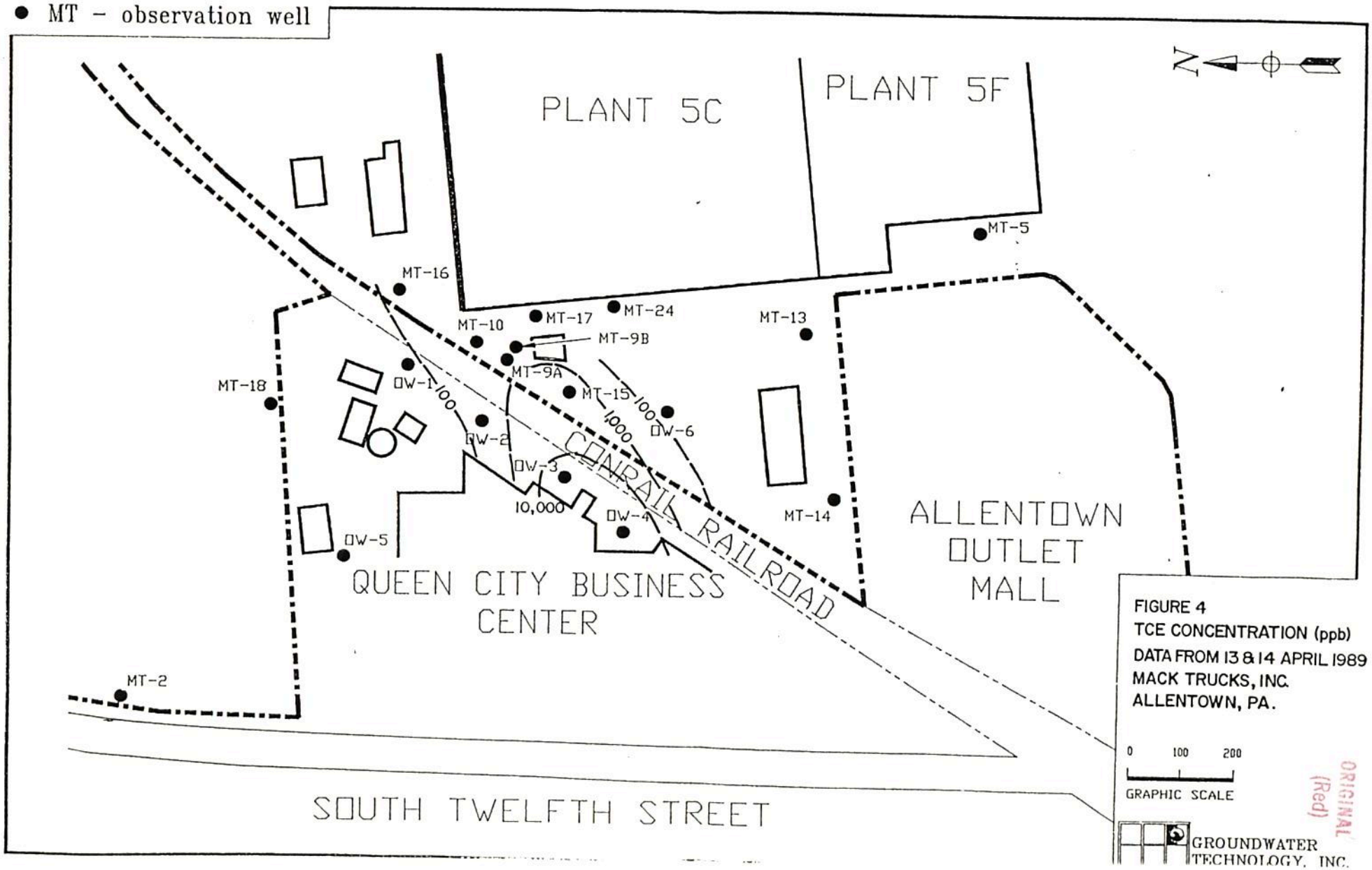
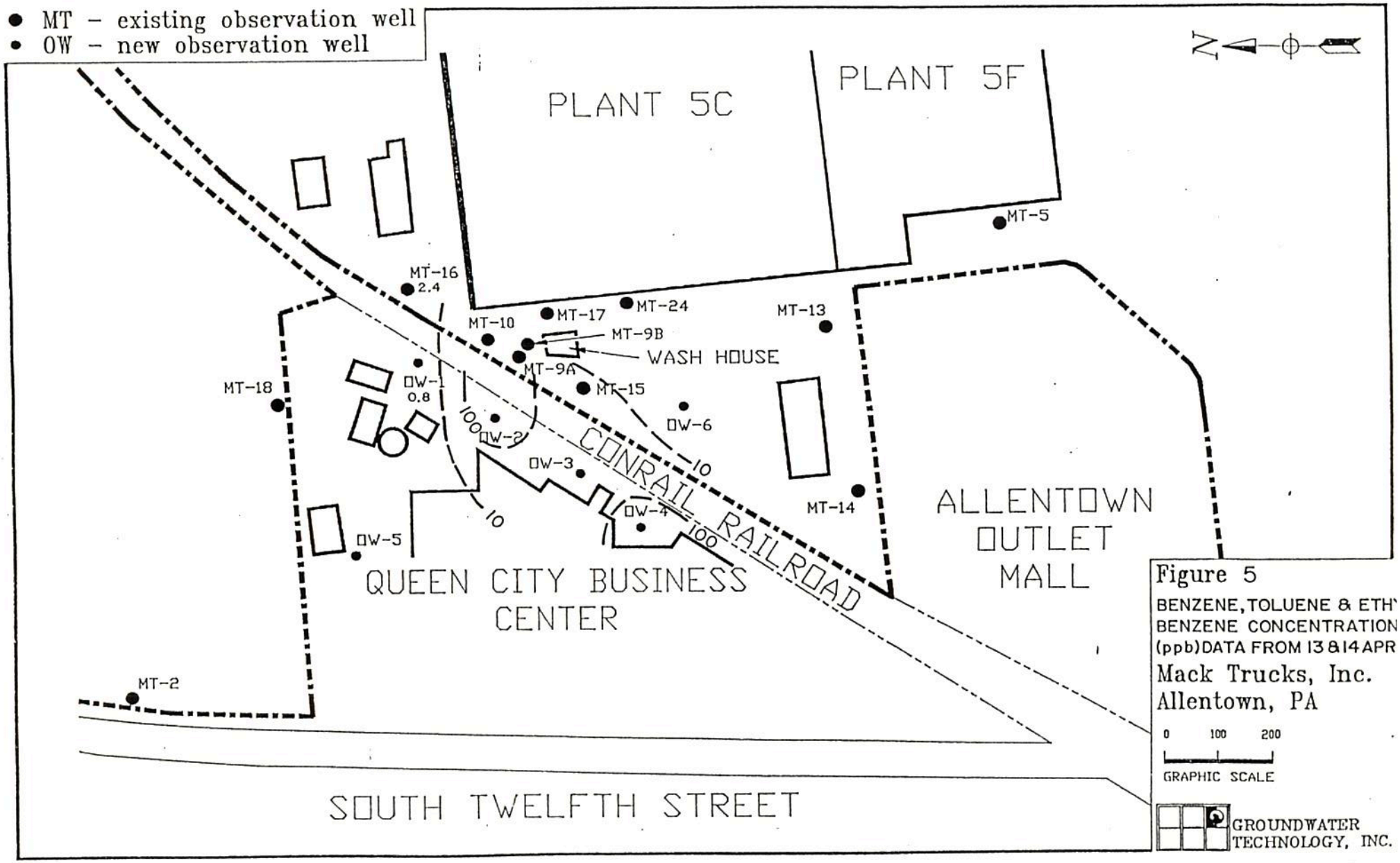
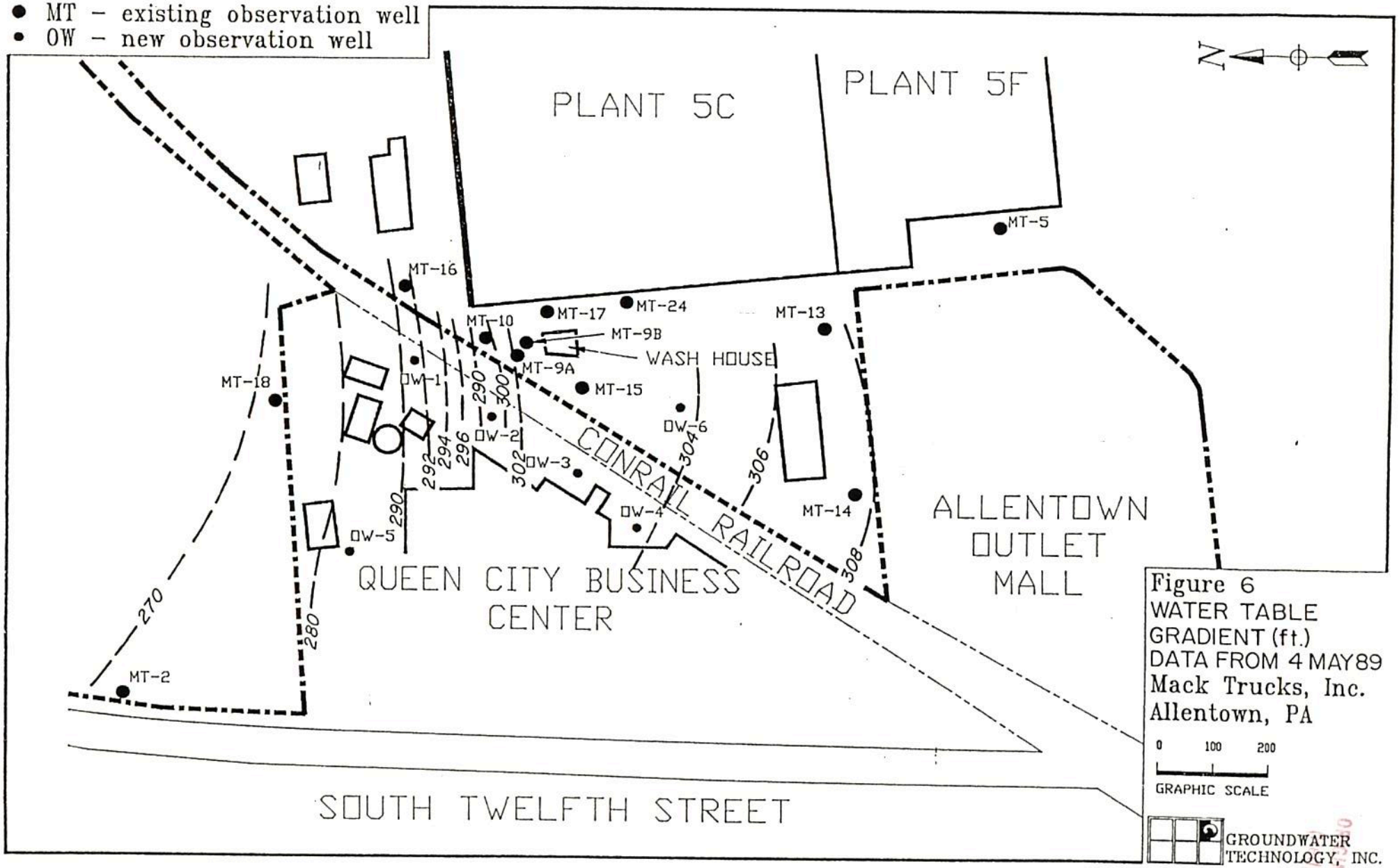
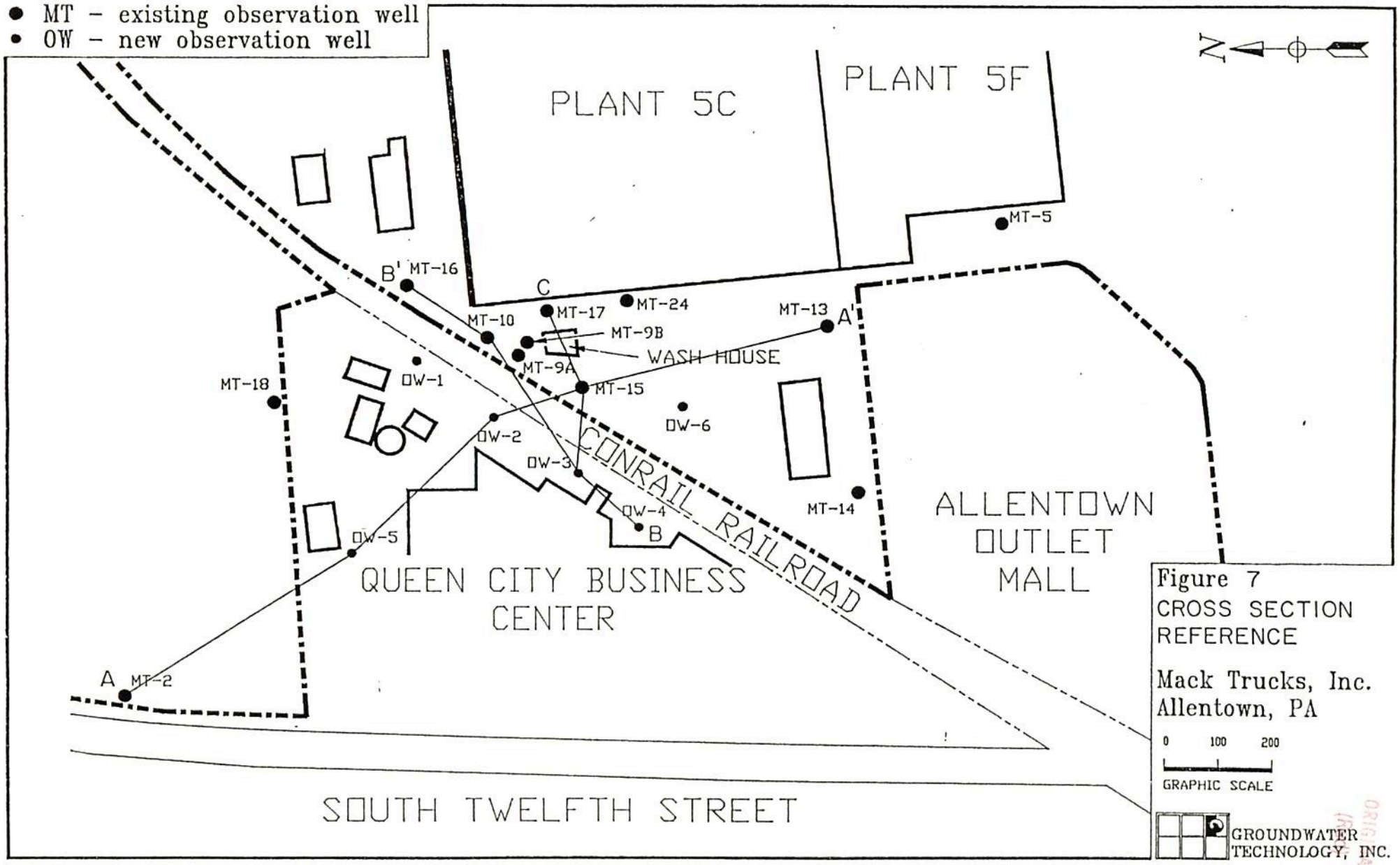

● MT – observation well
PLANT 5C
PLANT 5F
N
MT-5
MT-16
MT-10
MT-17
MT-24
MT-9B
MT-9A
MT-13
MT-18
OW-1
100
MT-15
1,000
100
OW-6
OW-2
OW-3
CONRAIL RAILROAD
10,000
OW-4
MT-14
ALLENTOWN OUTLET MALL
OW-5
QUEEN CITY BUSINESS CENTER
MT-2
SOUTH TWELFTH STREET
FIGURE 4
TCE CONCENTRATION (ppb)
DATA FROM 13 & 14 APRIL 1989
MACK TRUCKS, INC.
ALLENTOWN, PA.
0 100 200
GRAPHIC SCALE
GROUNDWATER TECHNOLOGY, INC.
ORIGINAL (Red)




MT – existing observation well
OW – new observation well
N
PLANT 5C
PLANT 5F
MT-5
MT-16
MT-17
MT-24
MT-10
MT-9B
MT-9A
WASH HOUSE
MT-13
MT-18
OW-1
MT-15
OW-6
OW-2
OW-3
OW-4
MT-14
OW-5
MT-2
270
280
290
292
294
296
300
302
304
306
308
CONRAIL RAILROAD
QUEEN CITY BUSINESS CENTER
ALLENTOWN OUTLET MALL
SOUTH TWELFTH STREET
Figure 6
WATER TABLE GRADIENT (ft.)
DATA FROM 4 MAY89
Mack Trucks, Inc.
Allentown, PA
0 100 200
GRAPHIC SCALE
GROUNDWATER TECHNOLOGY, INC.


MT – existing observation well
OW – new observation well
N
PLANT 5C
PLANT 5F
MT-5
B'
MT-16
C
MT-17
MT-24
MT-13
A'
MT-10
MT-9B
WASH HOUSE
MT-9A
MT-18
OW-1
MT-15
OW-6
OW-2
OW-3
CONRAIL RAILROAD
MT-14
OW-4
B
OW-5
ALLENTOWN
OUTLET
MALL
QUEEN CITY BUSINESS
CENTER
A
MT-2
SOUTH TWELFTH STREET
Figure 7
CROSS SECTION
REFERENCE
Mack Trucks, Inc.
Allentown, PA
0
100
200
GRAPHIC SCALE
GROUNDWATER
TECHNOLOGY, INC.

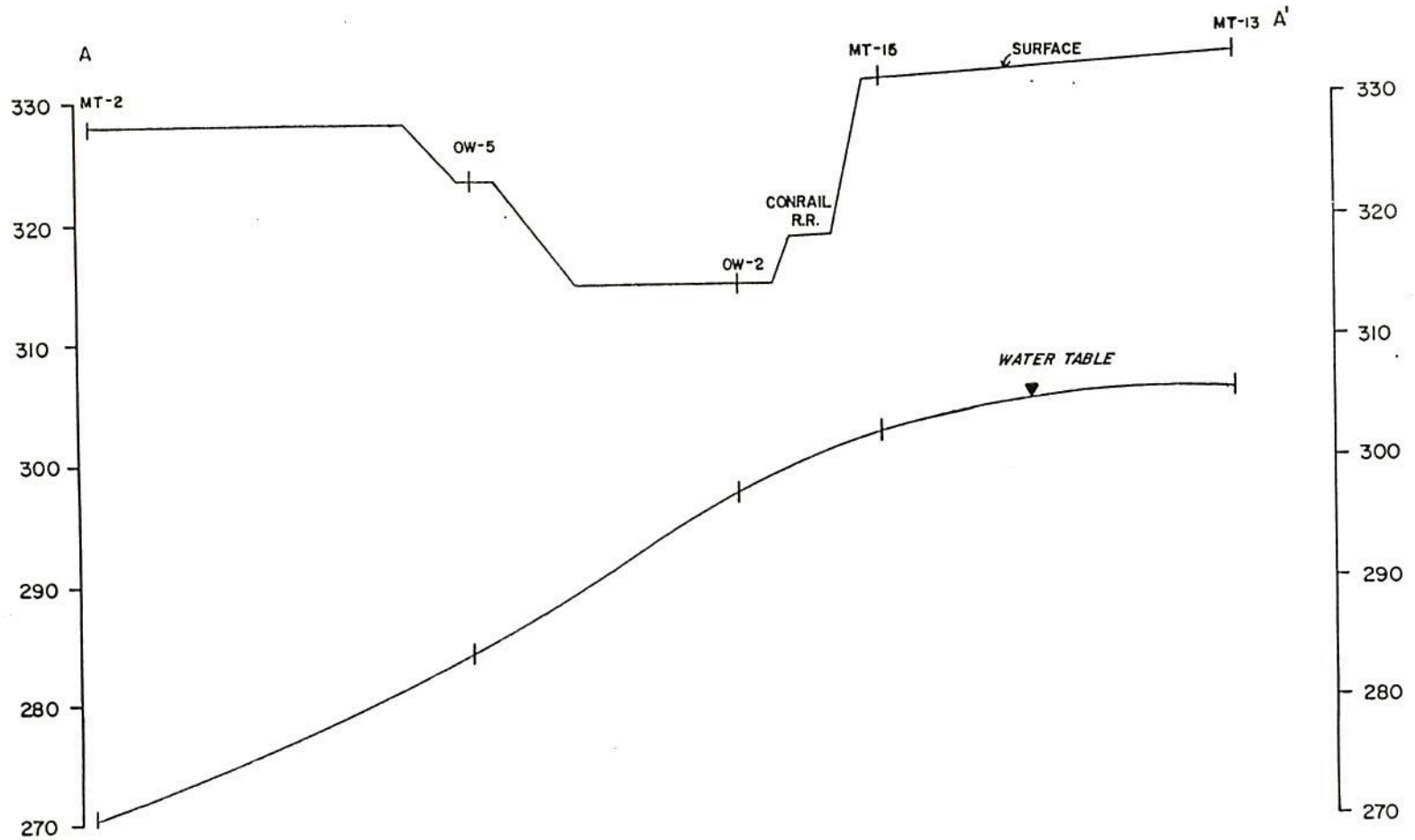


FIGURE 8
WATER TABLE CROSS SECTION A-A'
MACK TRUCKS, INC.
ALLENTOWN, PA.

GROUNDWATER
TECHNOLOGY, INC.

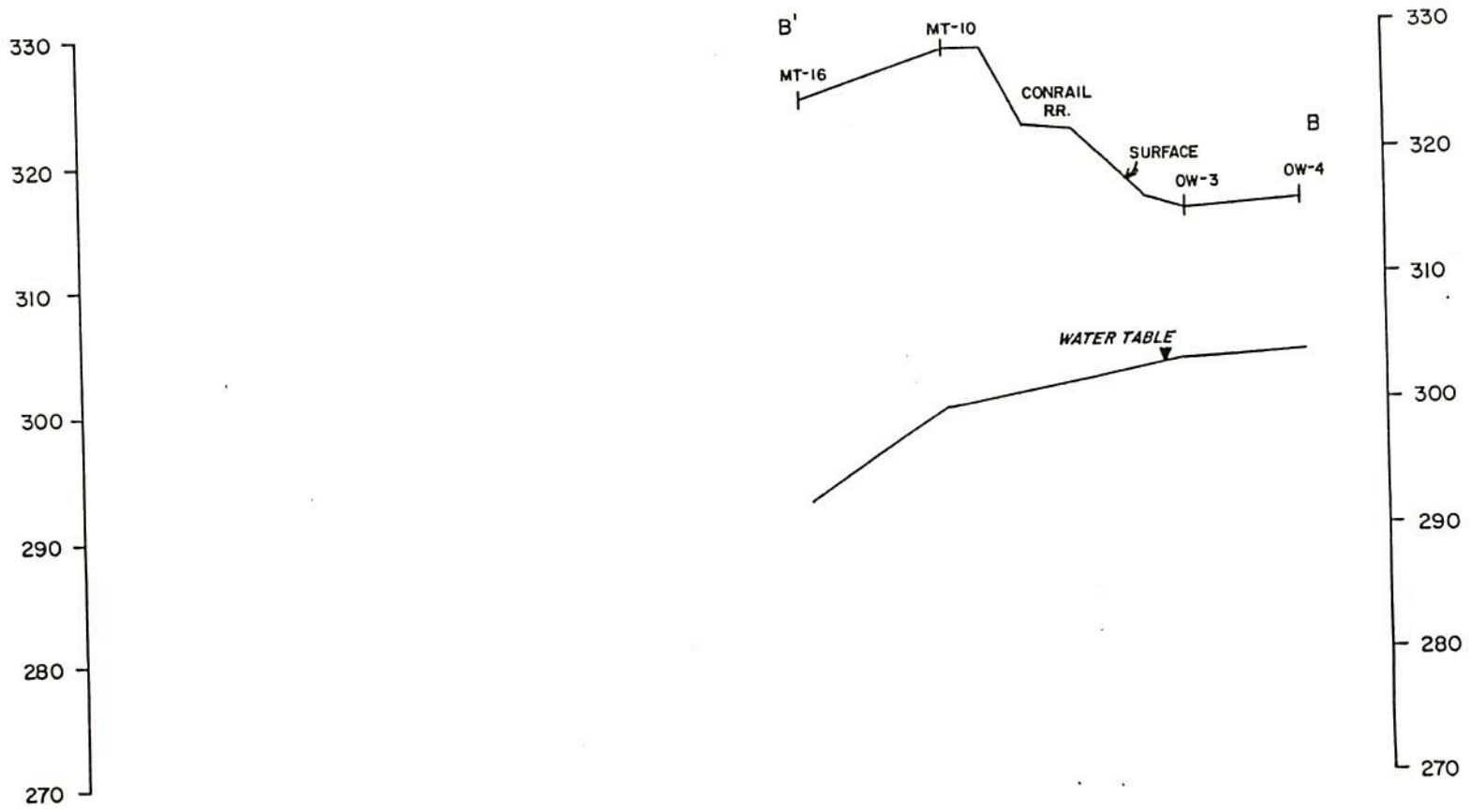


FIGURE 9
WATER TABLE CROSS SECTION B'-B
MACK TRUCKS, INC.
ALLENTOWN, PA.

GROUNDWATER
TECHNOLOGY, INC.

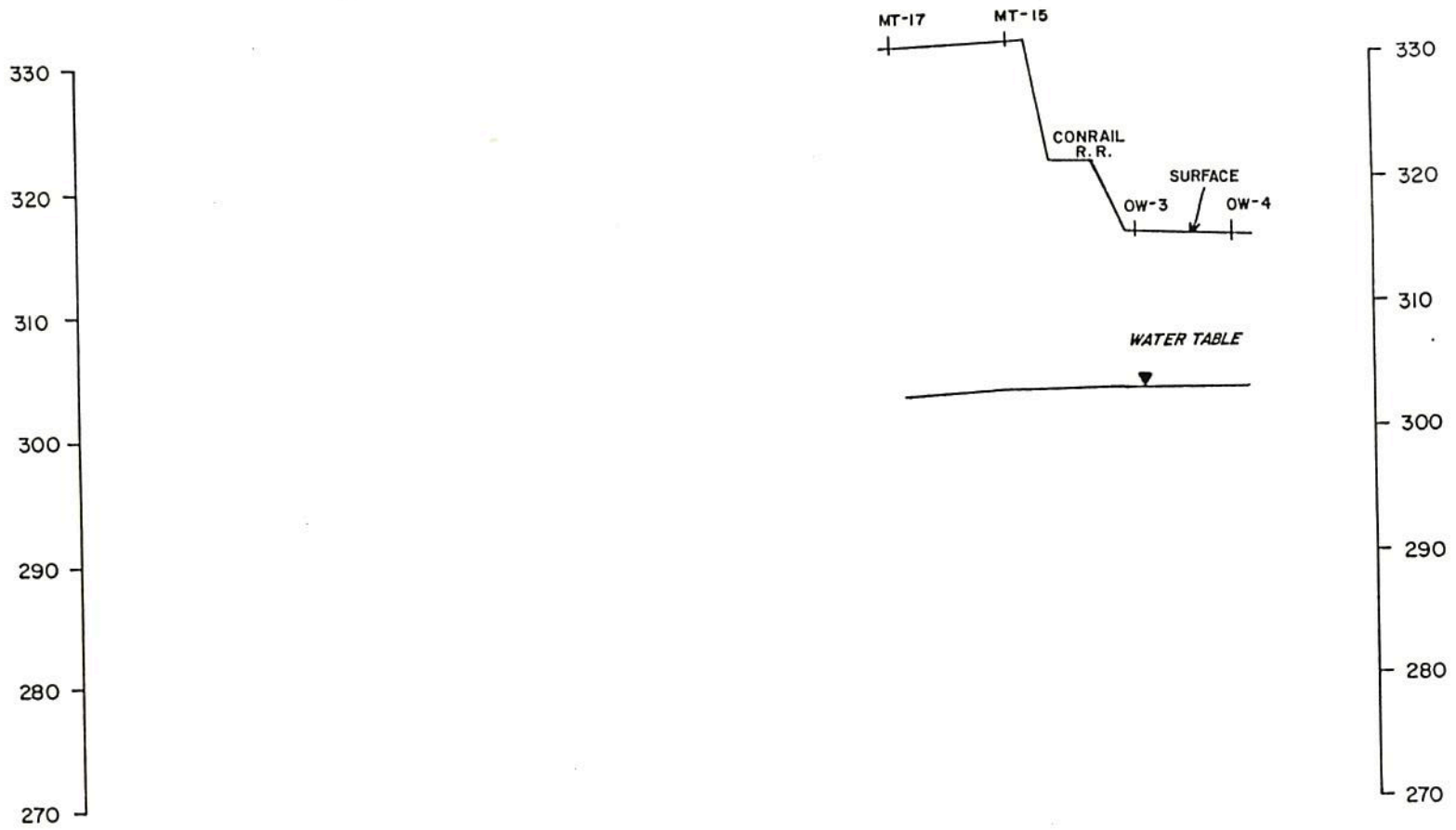


FIGURE 10
WATER TABLE CROSS SECTION C-B
MACK TRUCKS, INC.
ALLENTOWN, PA.

GROUNDWATER
TECHNOLOGY, INC.